REMARKS

The present amendment is in response to an office action dated April 4, 2002. The application now contains claims 2, 3, 6-15, 17-44, 46-54, and 56-60. Claims 2, 3, 6, 9-15, 17, 20-21, 24-26, 31, 39-42, and 46-54 have been amended. Claims 1, 4, 5, 16, 45, and 55 have been canceled and claims 56-60 have been added. A marked up copy of the amended claims is attached hereto. Claims 2, 6, 9, 10, 26, 31, 39, and 49 have been placed in independent form.

Examiner states that the title is not descriptive. The amended title, "A Method and Device for Polarization-Based All-Optical Switching," is more descriptive because it adds the words "Polarization-Based."

Examiner states that the abstract is not in the proper language and format, and uses legal phraseology such as the word "said." The amended abstract avoids the use of legal phraseology.

Claims 1 and 45 stand rejected under 35 U.S.C. 112 second paragraph for being indefinite. Claims 1 and 45 are also rejected under 35 U.S.C. 102(e) as being anticipated by Dultz et al, US Patent No. 6,331,910. These claims are canceled. The phrase "said polarizing surface" in claim 1, which caused the rejection under 35 U.S.C. 112, has been changed to "said polarizing beam splitting surface" in amended claims 2, 6, 9, and 10, which now include the limitations of claim 1 as explained below. Since this change in wording makes it clear that "said polarizing beam splitting surface" is the polarizing beam splitting surface referred to earlier in the claim, the amended claims 2, 6, 9 and 10 should be allowable under 35 U.S.C. 112 second paragraph.

Claim 9 stands rejected under 35 U.S.C. 102(e) as being anticipated by Dultz et al, US Patent No. 6,331,910. Claim 9 is amended to specify that the incidence angle of the beam on the controllable polarization rotator (CPR) is an angle other than 90 degrees. This limitation is supported in the application by Fig. 7 and its description, which states (page 18, lines 2-3), "The incidence angles of the beam components with respect to the CPRs 614A and 614B, respectively, are of 45 degrees." In Dultz et al, the incidence angle of the light beam on the CPR (labeled 6 in most of their drawings, and labeled 104 in their Fig. 2) is always 90 degrees.

Claims 3, 47, and 48 stand rejected under 35 U.S.C. 103(a) as being unpatentable over US Patent No. 6,331,910 to Dultz et al. in view of US Patent No. 5,363,228 to DeJule et al. Claim 3 is amended to be dependent on claim 2, which renders the rejection

of claim 3 moot. In addition, a new claim 56 has the same limitation as old claim 3 but is dependent on claim 9 instead of claim 2. Claims 47 and 48 are amended so that the switches in these claims are according to claim 57, which renders the rejection of claim 47 and 48 moot. In addition, three new claims 58, 59 and 60 have the same limitation as old claim 48 but with the switch respectively according to claims 26, 31, and 39 instead of claim 57.

Examiner states that Claims 2, 4-8, 10-15, 20-23, 26-44, and 49-54 would be allowable if rewritten to include all the limitations of the base claim and any intervening claims which have been rejected. Claims 2, 6, 9 and 10 are rewritten to be independent claims which include all the limitations of their rejected base claim 1, so claims 2, 6, 9 and 10 should now be allowable. Claims 26, 31, 39, and 49 are rewritten to be independent claims which include all the limitations of their rejected base claim 16, so claims 26, 31, 39, and 49 should now be allowable. A new independent claim 57 has been written, which includes all the limitations of claim 16, and claims 20 and 21, whose base claim was claim 16, have been amended to be dependent on claim 57. Claim 20 as amended also includes all the limitations of the rejected intervening claims 17, 18, and 19, although this language is not explicitly included in the amended claim 20, since lithium niobate is a ferroelectric crystal exhibiting a linear electro-optic effect. Hence claims 20 and 21 should now be allowable.

The remaining claims are all dependent directly or indirectly on claims 2, 6, 9, 10, 26, 31, 49 or 57, so they should also be allowable. In particular, claims 11 and 12 have been amended to be dependent on claim 10. Claims 13-15 have been amended to be dependent on claim 2. Claims 17, 24 and 46 have been amended to be dependent on claim 26. Claim 50 has been amended to be dependent on claim 49, and claims 20, 21, 25, 40-42, 47, 48, 51 and 52 have been amended to be dependent on claim 57. The words: "the steps of" in claims 6 and 9 have been deleted. In amending claim 12 to be dependent on claim 10, the phrase "said medium is operated to provide a desired difference in phase delay in a range 0-$\lambda/2$ between two principal axes of said medium" has been deleted, because this limitation is already stated in claim 10, and "one of the output channels being blocked" has been changed to "one of the output channels is blocked" to make the claim grammatical after deleting the aforementioned phrase.

Claims 4 and 5 are canceled because their subject matter is adequately covered by claims 49 and 50.

For the reasons given, applicant respectfully requests that the Examiner allow all of the amended set of claims, as well as the amended title and abstract.

Respectfully submitted,
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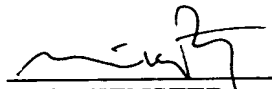

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MARKED-UP AMENDED CLAIMS

2. A switching [The] method [according to Claim 1] for selectively directing an input beam to at least one of two output channels, the method comprising:

(i) providing incidence of the input beam onto a polarizing beam splitting surface to thereby enable splitting of the input beam into two beam components of different polarizations propagating along different optical paths;

(ii) passing the input beam components of different polarizations through a controllable polarization rotating medium operable to selectively affect the polarization of each of the beam components; and

(iii) directing the beam components that have passed through the polarization rotating medium onto said polarizing beam splitting surface, thereby producing at least one output beam propagating towards at least one selected output channel, depending on a current mode of said medium,

wherein the input beam passes through the controllable polarization rotating medium prior to being split into said two beam components of different linear polarization states.

3. The method according to Claim [1]2, wherein steps (i) - (iii) are repeated with respect to said at least one output beam by directing it towards an additional polarizing beam splitting surface, and passing split beam components of said at least one output beam through an additional controllable polarization rotating medium capable of affecting polarizations of the split beam components, and an additional beam directing means that directs the beam components onto said additional polarizing beam splitting surface, thereby producing at least one additional output beam propagating towards a selected additional output channel.

6. A switching[The] method [according to Claim 1,]for selectively directing an input beam to at least one of two output channels, the method [and also] comprising [the steps of]:

(i) providing incidence of the input beam onto a polarizing beam splitting surface to thereby enable splitting of the input beam into two beam components of different polarizations propagating along different optical paths;

(ii) passing at least one of the split beam components of the input beam through an optical filtering means accommodated in the optical path of said at least one split beam component, thereby enabling to filter light that has interacted with the polarizing beam splitting surface to correct for an error introduced by the polarizing beam splitting surface;

(iii) passing the input beam components of different polarizations through a controllable polarization rotating medium operable to selectively affect the polarization of each of the beam components; and

(iv) directing the beam components that have passed through the polarization rotating medium onto said polarizing beam splitting surface, thereby producing at least one output beam propagating towards at least one selected output channel, depending on a current mode of said medium.

9. A switching[The] method [according to Claim 1,]for selectively directing an input beam to at least one of two output channels, the method [and also] comprising [the steps of]:

(i) providing incidence of the input beam onto a polarizing beam splitting surface to thereby enable splitting of the input beam into two beam components of different polarizations propagating along different optical paths;

(ii) providing incidence of said split beam components of the input beam onto a controllable polarization rotating[said] medium operable to selectively affect the polarization of each of the beam components, with [a certain]an incidence angle other than 90 degrees;

(iii) passing the input beam components through said medium; and

(iv) directing the beam components that have passed through the polarization rotating medium onto said polarizing beam splitting surface, thereby producing at least one output beam propagating towards at least one selected output channel, depending on a current mode of said medium.

10. A switching[The] method [according to Claim 1]for selectively directing an input beam to at least one of two output channels, the method comprising:

(i) providing incidence of the input beam onto a polarizing beam splitting surface to thereby enable splitting of the input beam into two beam components of different polarizations propagating along different optical paths;

(ii) passing the input beam components of different polarizations through a controllable polarization rotating medium operable to selectively affect the polarization of each of the beam components; and

(iii) directing the beam components that have passed through the polarization rotating medium onto said polarizing beam splitting surface, thereby producing at least one output beam propagating towards at least one selected output channel, depending on a current mode of said medium,

wherein said medium is operated to provide a desired difference in phase delay in a range 0 - $\lambda/2$ between two principal axes of said medium, thereby enabling to obtain desirable partition between the two output channels.

11. The method according to Claim [1]10, used for multicast switching.

12. The method according to Claim [1]10, wherein [said medium is operated to provide a desired difference in phase delay in a range 0-$\lambda/2$ between two principal axes of said medium] one of the output channels [being] is blocked, thereby enabling variable attenuating.

13. The method according to Claim [1]2, wherein an electrostatic field applied to said medium is selected such as to compensate for a hysteresis phenomenon occurring in said medium.

14. The method according to Claim [1]2, wherein an electrostatic field applied to said medium is selected so as to fit phases of the beam components passing therethrough, thereby compensating for a phase shift caused by beam reflection effects during the beam propagation.

15. The method according to Claim [1]2, wherein an electrostatic field applied to said medium is such as to cause a difference of $\lambda/2$ in phase delay between the split beam

components of different polarizations, the method thereby enabling to reduce switching differential voltage requirements.

17. The device according to Claim [16]26, wherein said medium is of a kind based on an electro-optic effect.

20. The device according to Claim [19]57, wherein said [ferroelectric crystal]medium is lithium niobate ($LiNbO_3$).

21. The device according to Claim [17]57, wherein said [electro-optic effect is]medium exhibits a quadratic electro-optic effect.

24. The device according to Claim [16]26, wherein said medium is made of a liquid crystal (LC) material.

25. The device according to Claim [16]57, operating as one of the following switches: 1x2, 2x1, and 2x2.

26. An all-optical switch[The] device [according to Claim 16]for selectively directing an input beam to at least one of two output channels, the device comprising:

(a) a polarizing beam splitting surface capable of splitting an input beam into two beam components of different polarizations and directing the split beam components to propagate along different optical paths, and capable of combining two beam components of different polarizations to produce at least one output beam;

(b) a controllable polarization rotating medium accommodated in optical paths of the input beam components, and selectively operable to affect the polarization thereof; and

(c) beam directing means accommodated in optical path of the beam components passed through the polarization rotating medium for directing the beam components onto said polarizing beam splitting surface to thereby produce at least one output beam propagating towards at least one selected output channel,

wherein the controllable polarization rotating medium comprises two elements made of a polarization rotating material, and said beam directing means comprises two retro-

reflective elements associated with said two polarization rotating elements, respectively, so as to reflect the beam components of different polarizations of the input beam towards the polarization rotating elements, and reflect the beams passed through the polarization rotating elements onto said polarizing beam splitting surface.

31. An all-optical switch[The] device [according to Claim 16]for selectively directing an input beam to at least one of two output channels, the device comprising:

(a) a polarizing beam splitting surface capable of splitting an input beam into two beam components of different polarizations and directing the split beam components to propagate along different optical paths, and capable of combining two beam components of different polarizations to produce at least one output beam;

(b) a controllable polarization rotating medium accommodated in optical paths of the input beam components, and selectively operable to affect the polarization thereof; and

(c) beam directing means accommodated in optical path of the beam components passed through the polarization rotating medium for directing the beam components onto said polarizing beam splitting surface to thereby produce at least one output beam propagating towards at least one selected output channel,

wherein the beam directing means is at least partly incorporated within the controllable polarization rotating medium.

39. An all-optical switch[The] device [according to Claim 16]for selectively directing an input beam to at least one of two output channels, the device comprising:

(a) a polarizing beam splitting surface capable of splitting an input beam into two beam components of different polarizations and directing the split beam components to propagate along different optical paths, and capable of combining two beam components of different polarizations to produce at least one output beam;

(b) a controllable polarization rotating medium accommodated in optical paths of the input beam components, and selectively operable to affect the polarization thereof; and

(c) beam directing means accommodated in optical path of the beam components passed through the polarization rotating medium for directing the beam components onto

said polarizing beam splitting surface to thereby produce at least one output beam propagating towards at least one selected output channel,

wherein said polarizing beam splitting surface is a surface of a polarizing cubic beam splitter, which has three truncated corners forming three locally adjacent facets, such that the intermediate facet intercepts with a plane of said polarizing beam splitting surface, said polarization rotating means being in the form of a plate accommodated at the intermediate facet outside of the beam splitter and having a reflective surface, said beam directing means being formed by said reflective surface of the plate and reflective surfaces of the other two facets.

40. The device according to Claim [16]57, wherein said polarizing beam splitting surface is a surface of a polarizing beam splitter cube, said beam directing means including reflective surfaces of the polarizing beam splitter.

41. The device according to Claim [16]57, wherein said beam directing means are also accommodated in the optical path of the split beam components of the input beam to direct said beam components to the polarization rotating means.

42. The device according to Claim [16]57, and also comprising optical filtering means accommodated in the optical path of at least one of the split beam components propagating towards the controllable polarization rotating medium, thereby enabling to filter light passed through the polarizing beam splitting surface to correct for an error introduced by the polarizing beam splitting surface.

46. The device according to Claim [45]26, operating as one of the following switches: 1x2, 2x1, and 2x2.

47. A multi-stage all-optical switch structure comprising at least two switch devices, each constructed according to Claim [16]57, the structure thereby operating as one of the following switches: 1xn, 2xn, ..., mxn.

48. A multi-stage all-optical switch structure comprising [an array of at least first and second switch devices each comprising]:

(i) an array of at least first and second switch devices, each switch according to claim 57 [comprising:

(a) a polarizing beam splitting surface capable of splitting an input beam into two beam components of different polarizations, and directing said two beam components to propagate along different optical paths, and capable of combining two beam components of different polarization states into at least one output beam;

(b) a controllable polarization rotating means accommodated in optical paths of the two input beam components, and selectively operable to affect the polarization of each of the beam components; and

(c) beam directing means accommodated in optical path of the beam components passed through the polarization rotating means for directing the beam components of different linear polarization states onto said polarizing beam splitting surface so as to produce the at least one output beam propagating towards at least one selected output channel]; and

(ii) at least one beam directing element accommodated in an optical path of the output beam produced by the first switch device to direct said output beam onto a polarizing beam splitting surface of the second switch device.

49. A switching method for reducing crosstalk between output channels of a switching structure where output light signals are collected, the method utilizing beam propagation through the switching structure composed of three switch devices, each[constructed as] device [of claim 16]comprising:

(a) a polarizing beam splitting surface capable of splitting an input beam into two beam components of different polarizations and directing the split beam components to propagate along different optical paths, and capable of combining two beam components of different polarizations to produce at least one output beam;

(b) a controllable polarization rotating medium accommodated in optical paths of the input beam components, and selectively operable to affect the polarization thereof; and

(c) beam directing means accommodated in optical path of the beam components passed through the polarization rotating medium for directing the beam components onto

said polarizing beam splitting surface to thereby produce at least one output beam propagating towards at least one selected output channel;

and having two output channels, wherein the two output channels of the first switch device are two input channels of, respectively, the second and third switch devices, one of the output channels of the second switch device and one of the output channels of the third switch device being blocked to prevent light output therethrough, light signals collected at unblocked output channels of the second and third switch devices being thereby characterized by reduced crosstalk.

50. A switching method according to claim 49, for increasing a switching speed [utilizing beam propagation through a switching structure composed of three switch devices, each constructed as device of Claim 16 and having two output channels], wherein

[- the two output channels of the first switch device are two input channels of, respectively, the second and the third switch devices, one of the output channels of the second switch device and one of the output channels of the third switch device being blocked to prevent light output therethrough, light signals being collected at unblocked output channels of the second and third switch devices; -] the controllable polarization rotating medium of each of the three switch device is operable to rotate the polarizations of the beam components passing therethrough at an angle other than 90 degree.

51. The switching method for directing an input beam towards two output channels with a desired energy partition between the two output channels, the method utilizing light propagation through a switch device constructed according to Claim [16]57, wherein said medium is operated to provide a desired difference in phase delay in a range 0-$\lambda/2$ between two principal axes of said medium.

52. A switching method for directing an input beam towards a selected one of two output channels with the other output channel being blocked, to thereby enable variable energy attenuating, the method utilizing light propagation through the switch device constructed according to Claim [16]57, wherein said medium is operated to provide a desired difference in phase delay in a range 0-$\lambda/2$ between two principal axes of said medium.

53. A switching method for directing an input beam towards at least one output channel, the method utilizing light propagation through the switch device constructed according to Claim [16]57, wherein operation of said controllable polarization rotating medium is appropriately controlled to compensate for a hysteresis phenomenon occurring in said medium.

54. A switching method for directing an input beam towards at least one output channel in a manner to reduce switching differential voltage requirements, the method utilizing the switch device constructed according to Claim [16]57, wherein operation of said controllable polarization rotating medium is appropriately controlled such as to cause a difference of $\lambda/2$ in phase delay between the split beam components of different polarizations.